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(54) Electrophoresis devices.

(57) In electrophoresis, it is necessary for a gel plate assembly to be supported so that it is in contact with at least one buffer tank. The devices which provide such support are designed to take a gel assembly of a predetermined width. This necessitates the use of a plurality of such devices if gel assemblies of differing widths are to be accommodated, or that the support needs to be dismantled and re-assembled every time a gel assembly of a different width is to be used. Described herein is an improved electrophoresis device (10) which provides a variable width support (12, 14, 16) for a gel plate assembly (40). Adjusting means (50, 52, 70, 72) are provided for varying the width of the support (12, 14, 16) between at least two different values without the need for dismantling the support (12, 14, 16).

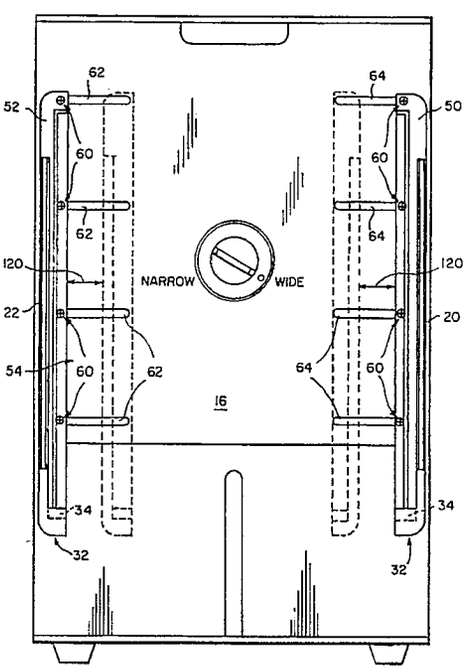

FIG. 2

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This invention relates to electrophoresis devices and particularly to the support it provides to a gel plate assembly.

In the field of electrophoresis, the sequencer device described in US-A-4 828 669 represents a marked improvement in devices providing for such processing of proteins and nucleic acids. Such a device comprises at least one support for a gel plate assembly, and at least one buffer tank in liquid communication with the plate assembly. Most preferably, the support comprises a pair of fixed rails of fixed width, the buffer tank(s) being constructed to fit around the end(s) of the rails. As described in US-A-4 828 669, the rails are preferably inclined slightly from the vertical to provide a resting surface for the plate assembly while it is being mounted on the support.

Although the above-mentioned device represents a marked improvement, it has one minor drawback - the width of the support as determined by the spacing of the fixed rails is fixed. This feature has in fact been standard on other electrophoresis devices as well. Gel plate assemblies come in a variety of widths, depending upon the number of sample lanes which are run within the gel. As a result, each electrophoresis device is usually dedicated to a fixed width, so that separate devices need to be constructed to accommodate differing widths of the gel plate assemblies.

More recently, an electrophoresis device has been described which allows for some width flexibility. This device is described on page 152 of the 1989 product catalog of BIORAD Laboratories as "Sequi-Gen Nucleic Acid Sequencing System", p. 152-154, and allows a single base and lower buffer tank to be used with gel plate assemblies of two different widths, namely 21cm and 38cm. However, this device requires complete disassembly and reassembly to change the width size. The entire gel plate support including the upper buffer tank is taken down and out of a "universal base" which provides the lower buffer tank, and a different gel plate support, gel plate assembly, and upper buffer tank is reassembled and inserted into that same base. Such variation in width is tedious and time-consuming, and requires different supports as well as a different upper buffer tank for each width, such tank being a fixed part of any given gel plate assembly.

Therefore, it has been a problem prior to the present invention to provide for a variable width electrophoresis device which accommodates variable widths of plates without requiring complete reassembly.

According to one aspect of the present invention, there is provided an electrophoresis device for electrophoretically separating charged compounds on a gel assembly, the device comprising:-

a support for mounting at least one gel plate assembly, and

a buffer tank mounted for liquid communication with the gel plate assembly mounted on the support;

characterized in that the support includes adjusting means for varying the width of the support between at least two different values to accommodate at least two different widths of gel plate assembly (40) on the same the support.

Accordingly, it is an advantageous feature of the invention that the same electrophoresis device is useful for a variety of widths (and lengths) of gel plate assemblies, rather than for a single dedicated width; without having to reassemble the support of the gel plate assembly.

It is a related advantageous feature of the invention that the electrophoresis device can be modified in its useful gel-plate width by the simple turn of a handle.

The present invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a side elevational view of an electrophoresis device constructed in accordance with the present invention;

Figures 2 and 3 are respectively a front and a rear elevational view of the device, taken along the lines II-II and III-III of Figure 1, the buffer tanks and gel plate assembly having been removed for clarity;

Figure 4 is a fragmentary front elevational view illustrating a bottom buffer tank mounted on the device;

Figure 5A is a sectioned view taken generally along the line 5A-5A of Figure 4;

Figure 5B is a sectioned view similar to that shown in Figure 5A, but with the support adjusted to a different width; and

Figure 6 is a fragmentary, partially schematic rear elevational view illustrating an alternate construction of the adjusting means for varying the width of the support.

The present invention is described hereinafter with respect to the preferred embodiments, wherein the electrophoresis device has certain features including removable top and bottom buffer tanks and a gel plate assembly support which is inclined from the vertical. In addition, the invention of variable width is useful with any electrophoresis device, whether or not it has removable buffer tanks and regardless of the number of such tanks, and whether or not the support is inclined from the vertical.

Referring to Figure 1, an electrophoresis device 10 is constructed to have a frame support 12 which in turn has a base 14 and a rising back frame 16 tilted preferably at an angle α of from about 5° to 10° from the vertical. As described in

US-A-4 828 669, this angle allows a gel plate assembly 40 to be assembled simply by leaning it against its supports. Those supports in turn comprise a pair of rails 20, 22 which extend generally parallel to each other as shown in Figure 2. Rails 20 and 22 are mounted for sliding movement towards and away from each other on back frame 16, as will be described hereinafter. A lower buffer tank 26 is mounted on plate assembly 40 with the latter immersed, as shown in Figures 1 and 4, and an upper buffer tank 36 is mounted at the upper end.

Both the lower and upper buffer tanks are constructed and mounted substantially as described for US-A-4 828 669 - that is, they clamp on to the front of the gel plate assembly 40 by clamping against rails 20 and 22. Accordingly, few details need be described here. . Clamps 28 are spring biased at 29, as shown in Figure 5A, to press gel plate assembly 40 against rails 20 and 22. The rails are inserted into the box portion 30 of buffer tank 26.

Rails 20 and 22, as shown more clearly in Figure 2, preferably have a bottom shoulder 32 constructed as described in US-A-4 828 669 to hold gel plate assembly 40. Shoulder 32 provides a front surface 34 which protrudes in front of plate assembly 40 to create a pocket which holds and supports the bottom edge 38 of that assembly 40.

The rails can have any convenient cross-sectional shape. An L-shape is preferred, as shown in Figure 5A, wherein the front leg 42 of the rail provides a front surface for contact and support of gel plate assembly 40. The opposite, rear surface of leg 42 is used for the clamp which holds upper buffer tank 36 in place (not shown), as described in US-A-4 868 669. .

Any convenient gel plate assembly can be used, which, as a minimum, provides a front glass sheet 44, a rear glass sheet 46, a spacer between them at the outside edges (not shown), and a gel 48 coated between the sheets. Preferably, a thermally-conducting sheet, such as a metal plate, is applied (not shown) to the back of sheet 46 to allow for better distribution of heat which builds up in the gel.

In accordance with one aspect of the present invention, means are provided for varying the width of the support, that is, the spacing between rails 20 and 22. Indeed, the construction is such as to allow adjustment in the width without dismantling the rails, unlike the prior art device.

Referring to Figures 2 and 3, rails 20 and 22 are carried by elongated holders 50 and 52, which slide across the front surface 54 of frame 16. Holders 50 and 52 in turn have studs or screws 60 projecting rearwardly from the holders, through horizontally extending slots 62, 64, in frame 16. Those slots are spaced vertically along frame 16, and extend only a fraction of the width of frame 16. The opposite ends 68 of screws or studs 60 are affixed to two separate control plates 70, 72, as shown in Figure 3, so that frame 16 is sandwiched between holders 50, 52 and plates 70, 72.

The control plates 70, 72 preferably overlap at their corners 74, 76, which overlie the general center 78 of frame 16. Horizontal slots 80, 82 extend partway from corners 74 and 76 and in turn overlap each other. Slots 80 and 82 allow control plates 70 and 72 to slide past a control shaft 86 which is rotatably mounted at center 78. Attached to shaft 86 behind frame 16 is a drive member disc 90, and to shaft 86 in front of frame 16 a handle 92, as shown in Figure 2. Drive disc 90 has mounted to it (Figure 3) at off-center locations 94 and 96, two drive members in the form of flexible rods 100 and 102. One end of each of rods 100 and 102 is affixed to disc 90 at locations 94 and 96, and the other end 110 of each rod is operatively connected to a rail 20 or 22, respectively, by reason of its attachment to control plate 70 or 72.

No particular shape is critical to either disc 90 or handle 92, although a generally circular shape is preferred.

The operation of the width-varying means will be readily apparent from the preceding: Manual rotation of handle 92 (Figure 2) causes rotation of disc 90 (Figure 3) to bring ends 94 and 96 of rods 100 and 102 either closer to center 78, or to push them farther away from the center. If they are drawn closer together, plates 70 and 72, as well as the attached holders 50, 52, (Figure 2) and the mounted rails 20, 22 also move closer together, in the direction indicated by arrows 120. In this fashion, the width of the support is changed from its maximum value, shown in solid lines in Figure 2, to a lesser value and eventually to the minimum width, shown in phantom in Figure 2. Any width in between can be selected as well, producing an infinite width variation between these two limits. A maximum width gel plate assembly 40 is illustrated in place with buffer tank 26 in Figure 5A, whereas a minimum width gel plate assembly 40 is illustrated with the same buffer tank 26 in Figure 5B. The change occurs, in the direction indicated by arrows 130, without once removing the gel plate support (rails 20 or 22) from device 10.

Thus, useful widths of gel plate assembly 40 can include 21 and 38cm, and any variation in between, for example.

Other drive and control mechanisms are equally useful in varying the spacing of rails 20 and 22, Figure 6 illustrating but one example. Parts similar to those previously described bear the same reference numeral, to which the distinguishing suffix "A" is appended.

Thus, device 10A is constructed exactly as

described above, so that rails 20A and 22A are connected, via their holders and studs (not shown) to control plates 70A and 72A, driven by control disc 90A mounted on shaft 86A, as before. However, in this embodiment control plates 70A and 72A are generally rectangular and have no slots. Instead, they slide between backing members 200, 202 affixed to frame 16A. Also, the flexible rods are replaced by a rack gear 210, 212 on each of plates 70A and 72A, which engage a pinion gear 220 on disk 90A. Rotation of disc 90A produces a longitudinal movement, in the direction of arrows 230, of control plates 70A, 72A to achieve movement of rails 20A and 22A, for width variation.

Claims

1. An electrophoresis device (10) for electrophoretically separating charged compounds on a gel assembly (40), the device (10) comprising:-

   a support (12, 14, 16, 20, 22, 50, 52, 70, 72; 16A, 20A, 22A, 70A, 72A) for mounting at least one gel plate assembly (40), and

   a buffer tank (26, 36) mounted for liquid communication with the gel plate assembly (40) mounted on the support (12, 14, 16, 20, 22, 50, 52, 70, 72; 16A, 20A, 22A, 70A, 72A);

   characterized in that the support (12, 14, 16, 20, 22, 50, 52, 70, 72; 16A, 20A, 22A, 70A, 72A) includes adjusting means (50, 52, 70, 72, 86, 90, 92, 100, 102; 70A, 72A, 86A, 90A, 200, 202, 210, 212) for varying the width of the support (12, 14, 16, 20, 22, 50, 52, 70, 72; 16A, 20A, 22A, 70A, 72A) between at least two different values to accommodate at least two different widths of gel plate assembly (40) on the same the support (12, 14, 16, 20, 22, 50, 52, 70, 72; 16A, 20A, 22A, 70A, 72A).

2. A device according to claim 1, wherein the support (12, 14, 16, 20, 22, 50, 52, 70, 72; 16A, 20A, 22A, 70A, 72A) includes two opposed rails (20, 22; 20A, 22A) each being slidably mounted for movement both toward and away from one another.

3. A device according to claim 2, wherein each rail (20, 22; 20A, 22A) includes a holder (50, 52) constructed to fit around the side edge and front edge of the gel plate assembly (40) to form an adjustable pocket which accommodates the actual width of the at least two different gel plate assemblies (40).

4. A device according to any one of claims 1 to 3, wherein the adjusting means (50, 52, 70, 72, 86, 90, 92, 100, 102; 70A, 72A, 86A, 90A, 200, 202, 210, 212, 220) comprise a manual control member (92), rotatable mounting means (86, 90, 100, 102; 86A, 90A, 200, 202, 210, 212, 220) for rotatably mounting the control member (92) between the rails (20, 22; 20A, 22A) to rotate about an axis on the device, and a drive member (100, 102; 210, 212, 220) for each of the rails (20, 22; 20A, 22A).

5. A device according to claim 4, wherein each drive member (100, 102) has one end (110) operatively secured to its associated rail (20, 22) and the other end operatively engaging the control member (92) off-center with respect to the axis, rotation of the control member (92) moves each of the drive members (100, 102) and its respective rail (20, 22) closer to or farther from the axis and from the opposite rail.

6. A device according to claim 5, wherein the other end of the drive member (100, 102) is eccentrically attached to the control member (92).

7. A device according to claim 4, wherein the rotatable mounting means (86A, 90A) includes a pinion gear (220) and the drive members each include a rack (210, 212) arranged to engage the pinion gear (220).

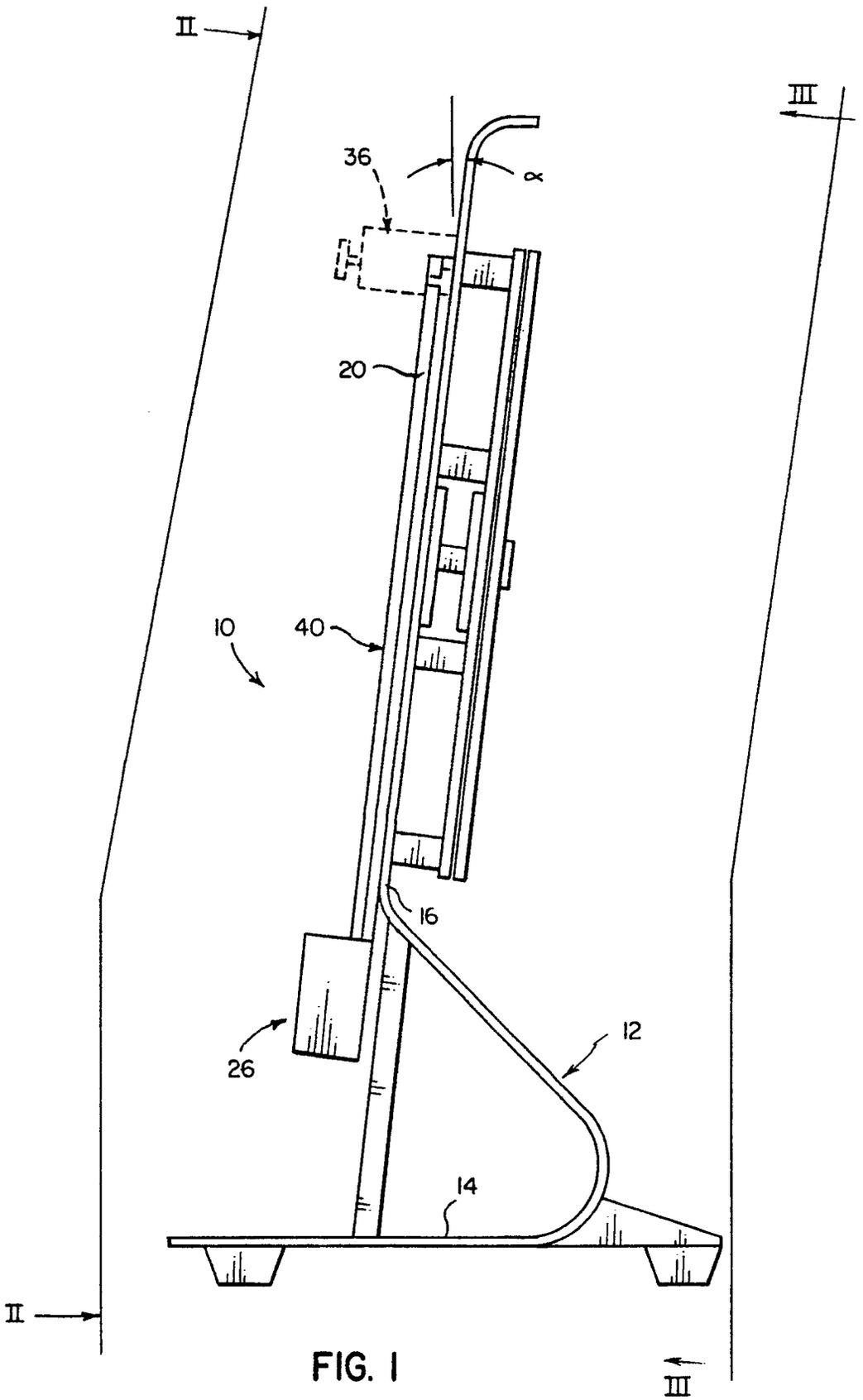

FIG. 1

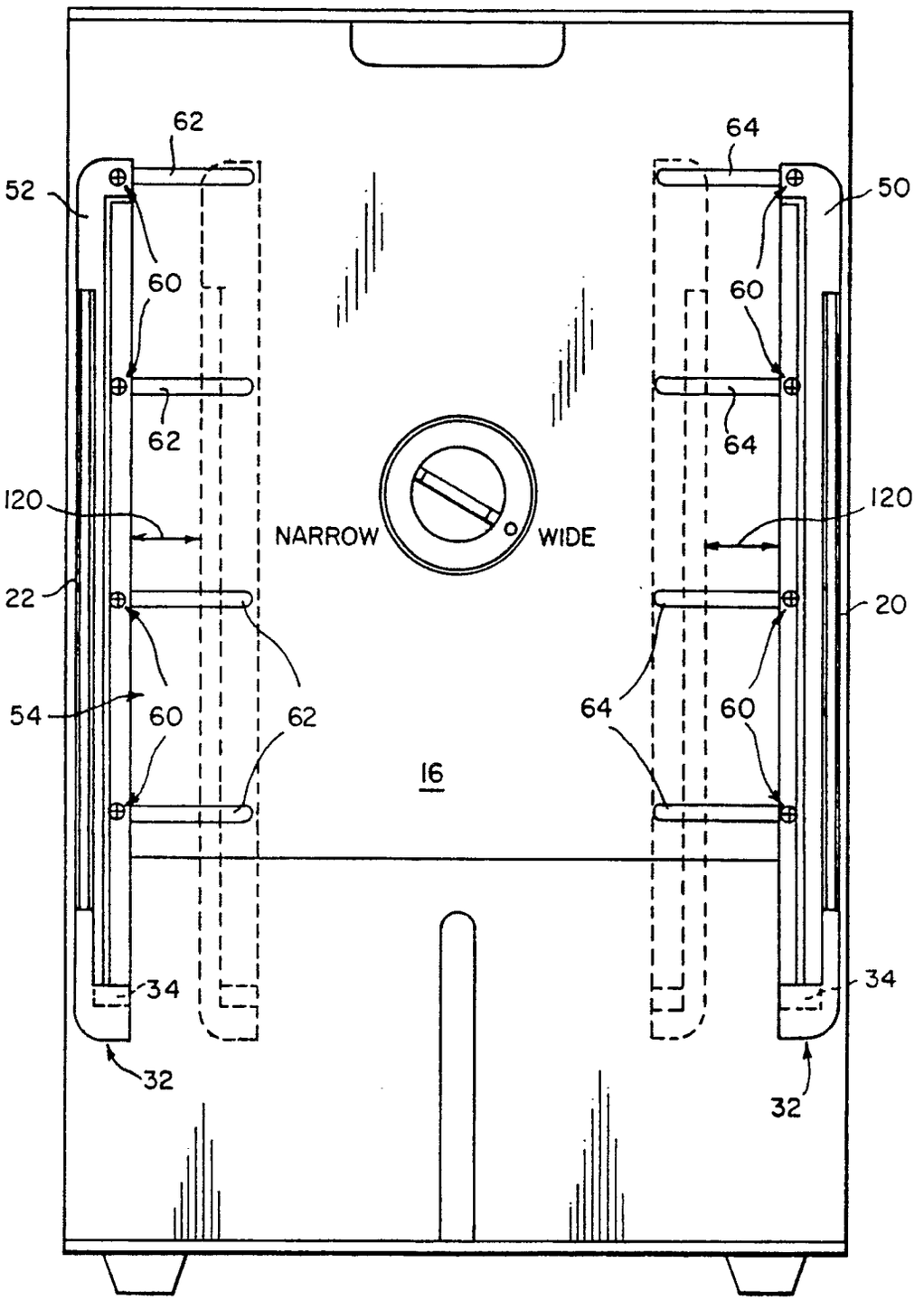
62
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FIG. 2

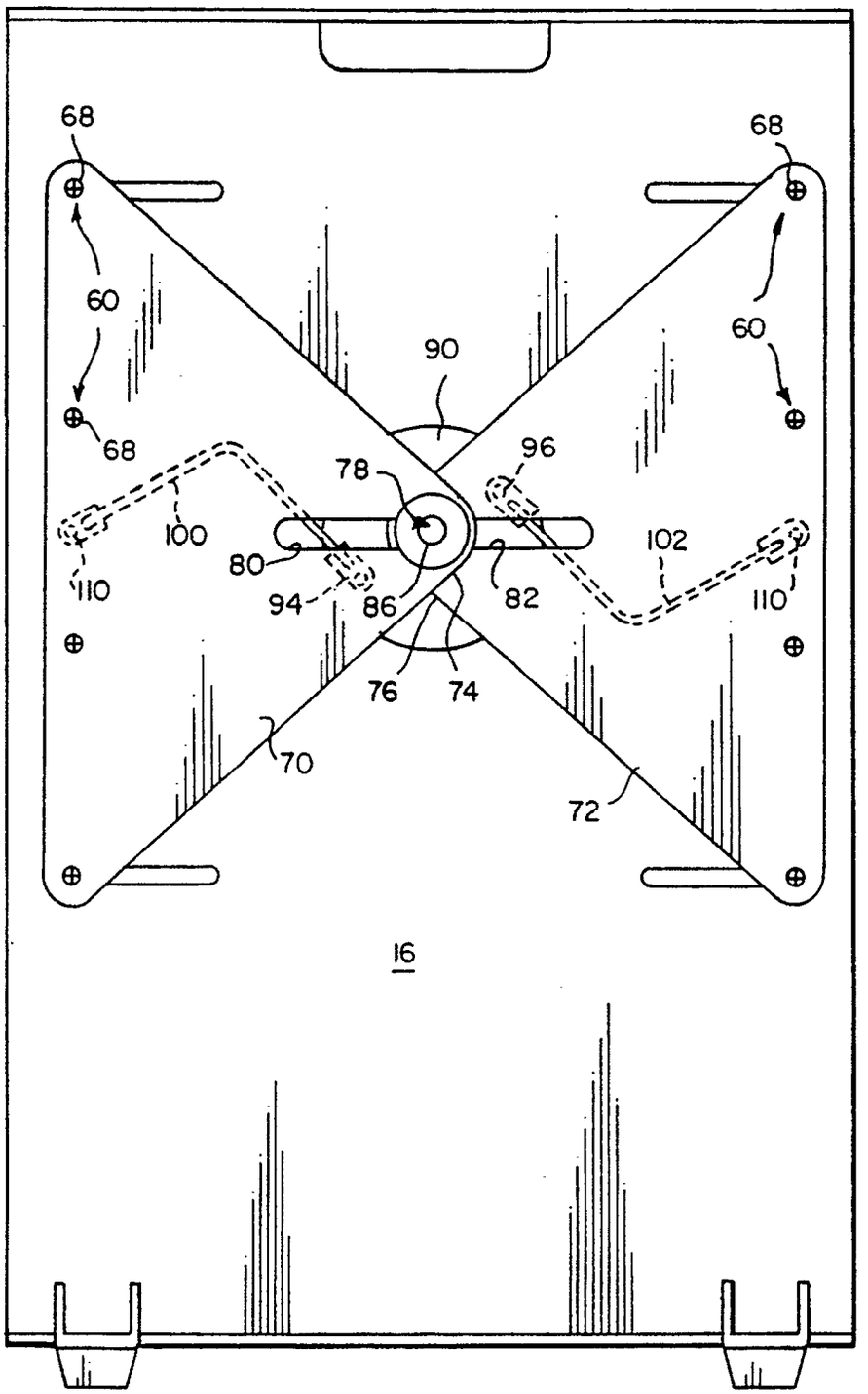

FIG. 3

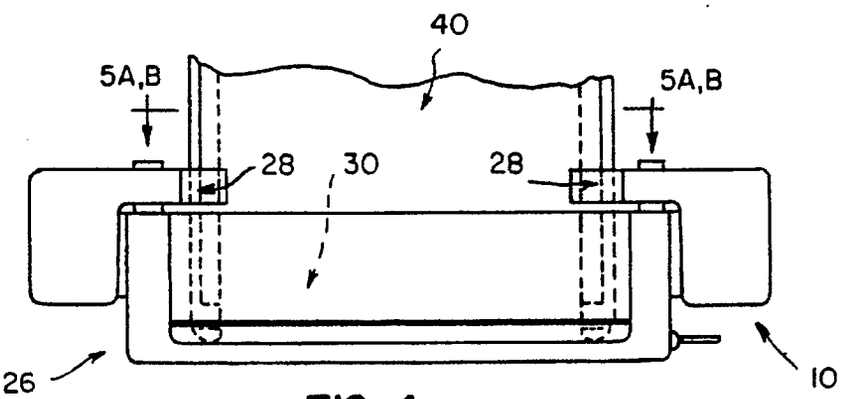

FIG. 4

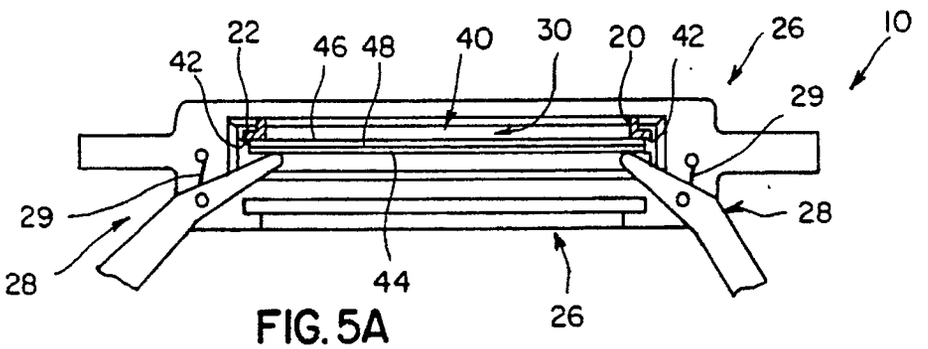

FIG. 5A

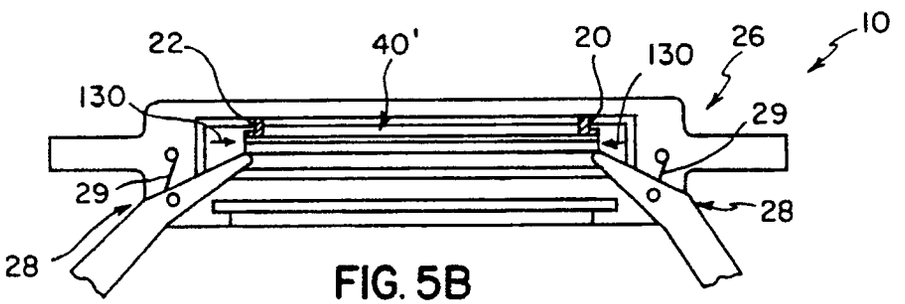

FIG. 5B

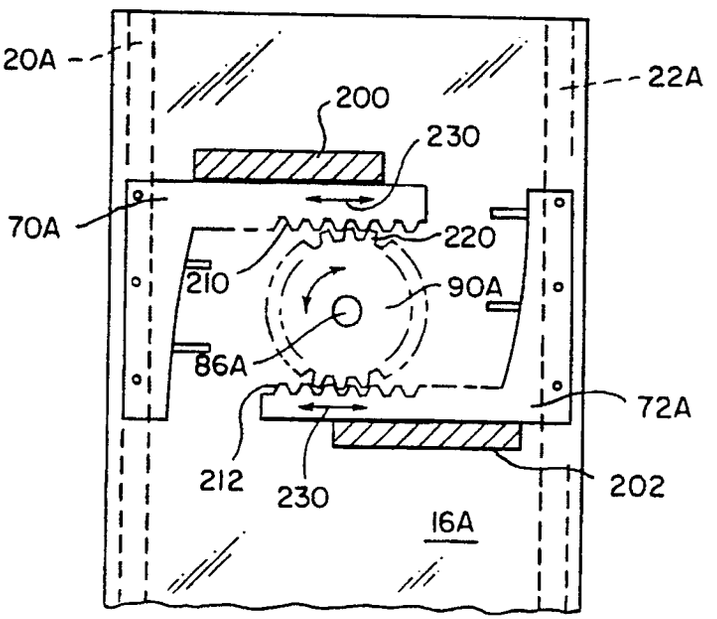

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 1328

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	FR-A-1 343 548 (J. HRDINA) * figures 1,2 *	1	G 01 N 27/447
A	US-A-3 290 240 (E. J. NEREN) * figure 2 *	1	
D,A	US-A-4 828 669 (R. R. HELLMAN) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G 01 N

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	12 August 91	DUCHATELLIER M.A.

CATEGORY OF CITED DOCUMENTS

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